

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 10852 (2012): Storage and Transportation of Sponge iron, Direct Reduced (DRI) and Hot Briquetted Iron (HBI) – Guidelines [MTD 30: Sponge Iron and Smelting Reduction]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

स्पंज लौहा, प्रत्यक्ष अपचयित लौहा (डी आर आई) एवं तप्त
इष्टिकाकृत लौहे (एच बी आई) का भंडारण एवं परिवहन
के लिये मार्गदर्शी सिद्धांत
(पहला पुनरीक्षण)

Indian Standard

STORAGE AND TRANSPORTATION OF SPONGE IRON,
DIRECT REDUCED (DRI) AND HOT BRIQUETTED
IRON (HBI) — GUIDELINES
(*First Revision*)

ICS 73.060.10

© BIS 2012

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Sponge Iron and Smelting Reduction Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Sponge iron/DRI has gained great prominence in India as a substitute of steel scrap (partially or fully) in steel making in electric arc furnace and induction furnace. Since, sponge iron has a tendency to re-oxidize and is a non-equilibrium product, care has to be taken to prevent it from returning to its equilibrium state, during its storage and transportation. It was, therefore, felt necessary to formulate this standard to facilitate the producer and the consumer to follow certain guidelines to take necessary preventive measures during handling, storage and transportation of sponge iron.

Sponge iron has a tendency to re-oxidize, if heated in the presence of oxygen to its ignition temperature of approximately 200°C or if it comes in contact with moisture or moist air. This is because of the high specific surface area of sponge iron and its state of non-equilibrium after oxygen is removed from iron oxide.

The specific surface area is a function of the process operating temperature. Solid reductant based direct reduced (DR) processes normally operate at a temperature of around 950-1050°C resulting in larger particle size and hence lower specific surface area offering a better resistance to re-oxidation. The resistance to re-oxidation is also increased because the surface pores are partially closed. In gaseous reductant based DR processes, due to counter-current solid-gas flow and relatively lower operating temperatures of 850-980°C, the product is relatively less stable. Besides passivation, an uncommon practice now-a-days, to prevent re-oxidation, hot briquetting of DRI is widely resorted to. However, this is not essential particularly when steel making unit is close to the sponge iron making unit and sponge iron is consumed within a short period of time. In this situation, in order to utilize the sensible heat of DRI for power savings in steel making operations, sometimes transport of hot DRI (HDRI) in especially designed sealed containers under inert atmosphere, through pneumatic means, by direct gravity feed to electric arc furnace or through sealed mechanical conveyor is practiced in many different plants.

Hot DRI at a temperature of 650-700°C in the form of reduced pellets, lumps or fines is passed through hot briquetting machines where it is pressed in between the rolls at extremely high pressure to produce highly compacted pillow shaped material (Size, length: 90-30 mm, width 80-100 mm and thickness 20-50 mm), called hot briquetted iron (HBI). HBI is a denser form of DRI with substantial increase in density, owing to closure of major voids. Because of the considerably reduced surface area, the product becomes much more stable and safe for long distance transportation by road and sea.

This standard was first published in 1984. While reviewing this standard, in the light of the experience gained during these years, it was decided by this Committee to revise this standard with the following main modifications:

- a) Title of the standard has been changed to incorporate hot briquetted iron (HBI).
- b) Treatment of air passivation has been incorporated before loading in ship.
- c) Special precautions for transportation of sponge iron produced by gaseous reductant based DR processes in sea-going vessels have been modified to incorporate the existing practice followed in the country and the world.

In this standard, assistance has been derived from 'Code of Safe Practice for Solid Bulk Cargoes (BC Code), 1998 edition', issued by International Maritime Organization, London (IMO).

Indian Standard

STORAGE AND TRANSPORTATION OF SPONGE IRON, DIRECT REDUCED (DRI) AND HOT BRIQUETTED IRON (HBI) — GUIDELINES

(First Revision)

1 SCOPE

This standard provides the guidelines for storage and transportation of sponge iron, DRI and HBI.

2 STORAGE

2.1 Storage Pile

Following guidelines should be followed for storage of sponge iron in a storage pile for longer duration.

2.1.1 The temperature of sponge iron should always be maintained below 65°C. Individual heap temperatures should be closely monitored at least once a day by inserting thermocouple probes with temperature gauges as close to the centre of the heap as possible.

2.1.2 Material should be kept in a dry state avoiding direct contact with water at all times.

2.1.3 Storage at all points should preferably be under cover (providing adequate ventilation) to protect from rain. The storage building should be designed in such a way that water entry from the sides is avoided. Sidewalls may not be required, if direct contact with water can be avoided but for complete protection, these may be necessary.

2.1.4 The storage area should be paved and levelled for a quick access, so that material can be isolated in case of accidental re-oxidation resulting in ignition. A minimum of outward slope (at least one in fifty) is required to allow water to drain out in case water accidentally enters the building.

2.1.5 Separation walls should be installed to divide the product in lots of about 2 000 t to avoid the possibility of re-oxidation and spontaneous combustion of the entire lot in the eventuality of a hot material finding its way into the pile. Ideally, the heap size should be maintained as small as practicable (say 100 t) with the largest possible extent of spreading (heap height 1.5 m, *Max*).

2.2 Storage in a Bin

The following points should be followed while storing the sponge iron in a storage bin:

- a) Sponge iron should be loaded dry and it should be below a temperature of 65°C. The bin temperature should be monitored regularly (at least once every day).
- b) Efforts should be made to avoid fines generation during loading into the bin and in order to prevent any material segregation and stagnation. Discharge should be smooth and even.
- c) Water intake to the bin should be avoided.
- d) The bin should be divided into segments to permit discharge from any compartment in case of eventual re-oxidation by accidental intake of hot material.
- e) Facilities for nitrogen/CO₂ purging should be available in case the bin temperature shows an increasing tendency.

3 TRANSPORTATION OF SPONGE IRON

3.1 The following aspects should be considered during transportation of sponge iron:

- a) Material should be loaded dry and it should be below a temperature of 65°C. Loading during rain should be avoided. If loading is done in an open area, direct contact with water should be avoided at all costs.
- b) Sponge iron (DRI), prior to shipping in commercial vessels, should be stored in small heaps of approximately 50-100 t on a dry concrete surface for 3 to 4 days in order to undergo air passivation. Thereafter, smaller heaps are to be accumulated into larger heaps of approx. 1000-2000 t on the ground for at least 24 h prior to loading for temperature monitoring (at least once every 4 h) to prevent any eventual re-oxidation. If during this period, the temperature rises beyond 65°C, the material should not be loaded into the vessel.
- c) Sponge iron, if transported by sea, should be loaded in holds which are water-tight, clean and dry. The vessels should have deck ventilators to vent out any small quantity of hydrogen generated. The vessel should have

nitrogen purging devices and sampling probe installed on each cargo hold to facilitate purging and measurement of oxygen and hydrogen concentration during purging as well as during voyage. Thermocouples with extended wiring should be installed in each cargo hold to facilitate continuous temperature measurement and an alarm in case of material re-oxidation and overheating, due to accidental external causes during the voyage.

- d) When sponge iron is transported by trucks, it is necessary to protect the material from coming into contact with water by using tarpaulin covers, which should not fly off during the journey.
- e) When sponge iron is transported by rail, closed wagons should be used.

CAUTION — After transportation by any of the modes mentioned above, storage should be in accordance with the guidelines enumerated above. In all handling of sponge iron, it has to be remembered that it is a non-equilibrium product and great care has to be taken to prevent it from returning to its equilibrium state. Direct contact with water and hot materials has to be avoided at all costs.

4 SUGGESTED SPECIAL PRECAUTIONS TO BE TAKEN FOR TRANSPORTATION OF SPONGE IRON, DIRECT REDUCED IRON (DRI)/HOT BRIQUETTED IRON (HBI) PRODUCED BY GASEOUS REDUCTANT BASED DIRECT REDUCTION PROCESSES IN SEA VESSELS

The following special precautions are suggested for the transportation of sponge iron produced by gaseous reductant based DR processes in sea-going vessels:

- a) A competent person should certify to the ship's master that the sponge iron loaded is stable and suitable for shipment.
- b) Sponge iron fines (under 3 mm) in the bulk should not exceed 5 percent at the time of loading.
- c) Sponge iron should not be loaded if the product temperature is greater than 65°C. Further, it should be loaded, stored and transported under dry conditions.
- d) If water enters the hold, hydrogen is likely to be evolved with the generation of heat. This may be sufficient to cause ignition. Hence, prior to loading, all holds should be completely clean, dry and watertight. Bilges should be sift proof and kept dry during the entire voyage. Wooden fixtures such as battens, etc, should be removed.
- e) During loading, sponge iron must either be

protected from exposure to rain or else loading should be stopped and hatches covered, Sponge iron which has been exposed to wetting should not be loaded.

- f) The ship should be equipped with systems for continuous monitoring of the temperature, and of oxygen and hydrogen concentrations during the voyage.
- g) The ship should be fitted with means of introducing inert gas immediately after completion of loading and be capable of maintaining an inert atmosphere during the voyage. The amount of inert gas introduced should be such as to keep oxygen concentration below 5 percent by volume. The hydrogen concentration should also be maintained below 1 percent by volume. The preferred inert gas is nitrogen, but if this is not available, carbon dioxide may also be used.
- h) If monitoring of hydrogen/oxygen or temperature during the voyage shows a continuous increase in hydrogen and/or rise in temperature, fire eruption situation may develop. In such cases, the ship should move for the nearest suitable port. Neither water, steam or additional carbon dioxide should be used at this stage to counteract the fire as a reaction with the cargo may result. If, however, nitrogen gas is available, the use of this gas shall keep the oxygen concentration down and will restrict the fire.
- j) Only certified safe electrical equipment and associated wiring should be installed in any cargo space or adjacent closed spaces or deck houses where flammable gases may accumulate. In such spaces, through runs of cables should be mechanically protected, have no joints and be of a type approved in oil tankers or be enclosed in heavy gauge screen steel conduits.
- k) Holds containing sponge iron may become oxygen depleted and all due caution shall be exercised upon entering such compartments.
- m) During discharge, the sponge iron should be kept dry.
- n) Any dust accumulated on decks or elsewhere during loading or discharge should be washed off as soon as possible to prevent adhesion since the dust is aggressive to painted steel.
- p) Radar, RDF scanners and other delicate equipment should be adequately protected against dust during loading and discharge operations.

Due to the much lower reactivity and higher thermal conductivity of HBI, the BC code is considerably less restrictive for transporting HBI. One of the most stringent requirements placed on transport of DRI that is maintenance of inert atmosphere containing less than 5 percent oxygen and less than 1 percent hydrogen in

the cargo spaces throughout the voyage, is not required for HBI.

Though all these precautions are necessarily applicable to sponge iron produced by gas based DR processes, they may also apply to solid reductant based sponge iron in some cases.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc No.: MTD 30 (4949).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones : 2323 0131, 2323 3375, 2323 9402

Website: www.bis.org.in

Regional Offices:

Telephones

Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 60 3843 60 9285
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	{ 2832 9295, 2832 7858 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.